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A Task Control Theory of Mirror-Touch Synaesthesia

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Abstract

Ward and Banissy's illuminating discussion of mirror-touch synaesthesia (MTS) encourages research testing *two* alternatives to Threshold Theory: their own Self-Other Theory, and 'Task Control Theory'. MTS may be due to abnormal mirror activity plus a domain-general, rather than a specifically social, impairment in the ability to privilege processing of task-relevant over task-irrelevant information.

Ward and Banissy (in press) argue convincingly that mirror-touch synaesthesia (MTS) is not due solely to atypically strong activation of the somatosensory system by visual observation of touching – to 'abnormal mirror activity' – and thereby make a compelling case for expansion of Threshold Theory. However, we propose that future research should encompass two alternatives: Self-Other Theory, the hypothesis that MTS is due to abnormal mirror activity plus an impairment in self-other processing; and what we will call Task Control Theory, the hypothesis that MTS is due to abnormal mirror activity plus a domain-general, rather than a specifically social, impairment in the ability to privilege processing of task-relevant over task-irrelevant information.

Task Control Theory is compatible with the two sets of findings that Ward and Banissy identify as troublesome for Threshold Theory: 1) *MTS does not only affect touch and pain perception*. Because it suggests that people with MTS have an impairment in a domain-general process, Task Control Theory predicts that they will have abnormal experiences, and show atypical patterns of behaviour, well outside the domains of touch and pain. 2) *Structural differences beyond the*

somatosensory system. Some areas of rTPJ/mPFC contribute more than others to self-other control. These areas may implement distinctive computations on social stimuli (strong specialisation), or receive more input from social stimuli, but process these in the same way as other areas of rTPJ/mPFC (weak specialisation; Sowden & Catmur, 2015). In either case, and in contrast with Self-Other Theory, Task Control Theory predicts that the grey matter density reduction observed in MTS will not be confined to socially specialised areas of rTPJ/mPFC, but rather will involve areas related to task-relevance (Cook, 2014).

Task Control Theory can also accommodate the evidence that Ward and Banissy cite as favouring Self-Other Theory over Threshold Theory. 1) *Self-awareness in MTS*. Individuals with MTS show the enfacement illusion and the rubber hand illusion without receiving, as part of the experimental procedure, the kind of experience that is normally necessary to induce these illusions, i.e. correlated experience of seeing touch and being touched themselves. These can be described as illusions of 'self-perception' – the participant has abnormal experiences relating to their own body – but it does not follow from this description that dedicated self-other processing is involved in generating the enfacement and rubber hand illusions, in people with MTS or in controls. In both populations these illusions could be due to abnormal mirror activity induced by associative learning prior to (MTS) or in (controls) the experimental context (Cook et al., 2014; Press et al., 2008). In that case, the illusion data are compatible with all three theories of MTS because all three postulate abnormal mirror activity. 2) *Self-other control mechanisms in MTS.* In the dot perspective task, people who report mirror-pain show a larger interference effect – e.g. slower responding when a central stimulus points to a smaller number of dots than the number the participant can see - than people who do not report mirror-pain (Derbyshire, Osborn & Brown, 2013). Self-Other Theory assumes that this interference is due to self-other processing, and therefore that its magnification in mirror-pain is due to an abnormality in self-other processing. In contrast, supported by evidence that controls show this interference effect when the central stimulus is inanimate, as well as when it is a human figure (Santiesteban et al., 2014), Task Control Theory suggests that the effect is larger in

people with mirror-pain because they have an impairment in domain-general mechanisms of task control.

In sum, we agree with Ward and Banissy that Threshold Theory requires extension, but propose that a domain-general extension would be consistent with existing data. Thus, future research on MTS should test both Self-Other Theory and Task Control Theory against Threshold Theory.

References

Cook, J. L. (2014). Task-relevance dependent gradients in medial prefrontal and temporoparietal cortices suggest solutions to paradoxes concerning self/other control. *Neuroscience and Biobehavioral Reviews, 42*, 298-302.

Cook, R., Bird, G., Catmur, C., Press, C. & Heyes, C. M. (2014). Mirror neurons: from origin to function. *Behavioural and Brain Sciences,* 37, 177-241.

Derbyshire, S. W. G., Osborn, J., & Brown, S. (2013). Feeling the pain of others is associated with self-other confusion and prior pain experience. *Frontiers in Human Neuroscience, 7*.

Press, C., Heyes, C. M., Haggard, P. & Eimer, M. (2008). Visuotactile learning and body representation: an ERP study with rubber hands and rubber objects. *Journal of Cognitive Neuroscience*, 20, 312-323.

Santiesteban, I., Catmur, C., Hopkins, S., Bird, G. & Heyes, C. M. (2014). Avatars and arrows: Implicit mentalizing or domain general processing? *Journal of Experimental Psychology: Human Perception and Performance,* 40, 929-937.

Sowden, S. & Catmur, C. (2015). The role of rTPJ in the control of imitation. *Cerebral Cortex*, 25(4): 1107-1113.